BACK

Improving the success of eelgrass (*Zostera marina*) restoration in the Pacific Northwest by using the three P's: Planning, Planting, and Performance

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Extended Abstract: The restoration of eelgrass (*Zostera marina*) in the Pacific Northwest is challenging because of a variety of factors, both known and unknown. The purposes of this extended abstract are: 1) to increase our understanding of eelgrass restoration in the Pacific Northwest, 2) to emphasize that most successful eelgrass restoration projects use an adaptive approach, and 3) to disseminate information and techniques that Battelle researchers have learned over the past few years, in the hopes of advancing the science of eelgrass restoration in the Pacific Northwest. Our approach involves carefully considering the "three P's" of eelgrass restoration to improve the chances of success. They are: Planning, Planting, and Performance.

Planning is the first step in any eelgrass restoration project and entails an understanding of the controlling factors, both physical and physiological, that influence eelgrass survival. Some of the disturbances known to affect the population structure of eelgrass include decreased light levels, salinity and temperature extremes, variable climate cycles, and physical disturbances, such as boat anchors, propeller wash, and shoreline modifications. However, even with our current understanding of the controlling factors for eelgrass growth and survival, we still can't explain some major losses, such as those occurring in Westcott Bay.

Two basic options are taken with eelgrass restoration in the Pacific Northwest: natural colonization or human intervention with transplantation. Natural colonization requires removal of the disturbance, the availability and close proximity of natural eelgrass beds, and plenty of patience for results, as there is a risk of colonization not occurring. The planting option, like natural colonization, also requires that the disturbance be removed. This option is often chosen because of the lack of natural eelgrass in the immediate vicinity, the expanse of the area, low seed production at the project site, or the need to accelerate the restoration process and produce quantifiable results. Each option, natural colonization or transplantation, relies on prior conditions specific to the project site; both methods have advantages and disadvantages. Natural colonization is a slower, less-expensive, and less-intrusive option compared with actively transplanting eelgrass. Additionally, in terms of mitigation requirements associated with anthropogenic impacts, plantings can help speed up recovery and restore ecological function.

In the second "P," *planting* questions need to be addressed, such as the location of donor material, planting methods, and planting density.

Transplanted eelgrass requires a supply of donor material. A main concern is to do no additional harm to existing eelgrass beds. One of the preferred places to collect donor material is from areas that will be affected by construction activities or overwater structures that cause shading unfavorable to eelgrass growth. Other alternatives for donor material include collection of drift eelgrass and seed shoots, as well as limited removal from unaffected eelgrass beds. We are currently studying the effects of different levels of harvesting on existing eelgrass beds. Typically, harvest levels have been restricted to 10% or less of the total abundance. This study is designed to examine a range of harvest levels above and below that most often employed. Each plot contains one subplot for each level of harvest (0%, 5%, 10%, 25%, 50%, and 100% of the shoots within a plot) plus a control subplot (thus, two subplots have no harvest). Shoot density was recorded within each plot prior to harvest. Results are currently pending monitoring.

Important considerations for determining planting density include the total area to be planted, the number of shoots to be planted, and a means of tracking under water what has been planted and where. The bundling and planting of eelgrass is fairly straightforward. A gentle technique and keeping the shoots in cool seawater as much as possible are conducive to success. We have used two apparatus to facilitate planting: tongue depressors and turf staples. Turf staples seem to hold the shoots better in the sediment and are now preferred. We have begun experimenting with other planting technologies, such as a method developed by the University of New Hampshire Jackson Estuary Lab, termed Transplanting Eelgrass Remotely with Frames (TERF), which has been used successfully in Narragansett Bay. We have also begun experimenting with seed dispersal platforms in conjunction with Sandy Wyllie-Echeverria and Chris Pickerell.

The main advantage to collecting and growing shoots in a confined environment are 1) a greater ability to control growth conditions and to monitor growth, and 2) an increase in population densities in a shorter period of time. Not only does stockpiling provide more shoots for initial plantings, it also provides donor material for multiyear plantings, supplemental plantings, and planting for unexpected disturbances. In the long run, propagation provides a cost-effective means of more rapidly providing the number of eelgrass shoots required for an eelgrass mitigation or restoration project.

The third and final "P" criterion is for *performance*. The criteria chosen to assess performance will define the success or failure of a given project. Performance criteria are measured through monitoring. Both quantitative and qualitative monitoring are required to supply details on patterns and rates of growth and to give indications of sources of disturbance. The resulting observations and associated data provide a realistic picture of eelgrass survival and trends. From our experience, we have learned that total shoot abundance and aerial coverage offer an ecologically realistic *performance* criterion and recommend that reference plots be used to evaluate site-specific trends.

Through the use of *planning*, *planting*, and *performance*, we have successfully demonstrated that eelgrass restoration is possible in the Pacific Northwest. We have used these principles to improve our own projects and hope that sharing this knowledge further improves the success of eelgrass restoration in the Pacific Northwest.

Biographical Sketch for JA Southard: John Southard is a fisheries biologist and the Dive Safety Officer in the Coastal Assessment and Restoration group at the Pacific Northwest National Laboratory Marine Sciences Laboratory. He has a strong background in fisheries, wildlife, ecology, and environmental policy and assessment. Mr. Southard is also an Emeritus SCUBA instructor with the National Association of Underwater Instructors (NAUI) and Technical Diving International (TDI), certified to teach mixed-gas diving to depths of 300 feet.